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THE RELATION OF THE OYSTERCATCHER TO ITS NATURAL ENVIRONMENT.

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I.—INTRODUCTION.

THE effective relation of an animal to its environment largely depends upon characters that are structural, physiological, and psychological. The more specialized these characters are, the more rigidly limited is the nature of the environment to which the animal is able to respond. The Oystercatcher is structurally specialized for a particular mode of feeding. Physiologically, it appears to need large quantities of bulky, soft food, such as shell-fish in winter, large earthworms and larvæ inland in summer, as it does not remain long in localities where these are not available. Psychologically, the individual behaviour is mostly stereotyped, and there is little evidence, short of the experimental, of any capacity for adjustment to environments which do not fulfil the special conditions of existence. Specialization secures the Oystercatcher from active competition with neighbouring forms, especially for food, but it necessarily results in the distribution of the species being discontinuous and dependent upon the simultaneous recurrence of complex and little variable environmental conditions.

1. *Areas under Observation and Method of Inquiry.*—The present communication reports the results of enquiries made on the south shore of the Firth of Forth during the winters 1906–1914 inclusive; on Loch Tummel, the lower portion of the River Tummel,

the River Garry below the village of Blair and in Glen Fender, all of which are in North Perthshire, during the summers 1909 to 1914 inclusive. The former represent the winter environment; the latter a summer environment of the Oystercatcher, no data being here included from the coastal breeding stations. Observations of a less continuous character were made in other localities as a means of control. No attempt was made to work out the local distribution in either the summer or the winter area, or to obtain experimental control of any environmental factors.*

On the Firth of Forth localities were noted where Oystercatchers were found to occur. By repeated observations it was ascertained whether the places were in permanent winter occupation or not. In the former case, the number of occupants was periodically estimated, and the environmental conditions were, as far as possible, discovered. *Mytilus edulis* was accepted as the chief food supply of the Oystercatcher. Where the birds were occasional visitors to important stations of *Mytilus*, or did not occur at all, the stations were regarded as potential Oystercatcher stations, and their conditions found. Two chief types of habitats were recognized on the sea-beach. These were compared intensively, in order to determine which might be the more favourable to the Oystercatcher.

In the summer environment three habitats were separated. The number of pairs per linear measure of loch, river, and hill-stream was used to determine the most favourable habitat. The conditions of all likely or occupied breeding-stations under observation were noted and compared to find those common to all the stations, those present only in the more favourable stations, and those wanting at potential stations. The results derived from the individual stations were then aggregated for the several habitats, and the conditions of the most suitable habitat discovered.

II.—THE WINTER ENVIRONMENT.

1. General Considerations.—The northern shore of the Firth of Forth, below the Forth Bridge, generally descends steeply into

* Valuable information on the areas under observation was obtained from the 'Memoirs of the Geological Survey of Scotland,' Nos. 32, 33, and 55; Appendix III. to the 'Weekly Weather Report' for 1906; the Admiralty Charts and Manual.



the sea, and the breadth of the littoral zone is small. The abruptness of the gradient is due to the passage of the deep north channel (the old river-bed) close by the northern shore. The exposure eastwards of Kinghorn to easterly and south-easterly storms is severe, and the beach is mostly rocky and sea-worn. The southern shore, on the other hand, descends gently into the bed of a shallow sea, and the depth of the littoral zone is, in most places, considerable. The greater part of the coastline is sheltered from storms. To the east of Weak Law, however, the shore falls more rapidly towards the sea; the littoral zone becomes narrower, and the rocks more and more sea-worn, as the exposure to the effect of storms and the depth of the adjacent waters increase. The distribution of the Oystercatchers is evidently affected by the general features of the coastline, for they are relatively scarce along the northern shore, plentiful on the south coast westward of Weak Law, and less numerous eastward on the open coast.

Geologically, the south coast shows an ascending series of rocks from east to west. Beginning in the Old Red Sandstone period, a change occurs in the vicinity of Weak Law to the Carboniferous series, which persists to and beyond the western end of the area. The sedimentary rocks have little importance in the present connection. The abundance of durable volcanic lavas and intrusions has a considerable indirect effect on the Oystercatcher population; the non-columnar form of analcite basalt being especially favourable to the formation of *Mytilus* settlements.

The average temperature for the whole year at Leith (5·5 metres above M. S. L.) is $8\cdot83^{\circ} \pm 3\cdot72^{\circ}$ C. The monthly means are $6\cdot16^{\circ} \pm 3\cdot00^{\circ}$ in November, $4\cdot11^{\circ} \pm 2\cdot83^{\circ}$ in December, and $3\cdot89^{\circ} \pm 2\cdot95^{\circ}$ in January (1871-1905).

The mean rainfall at Leith is 0·60 metre; the number of wet days, 179 (1871-1905).

The prevailing winds are westerly.

The ordinary spring tide rises 3·7 metres at Dunbar, 4·6 metres at Prestonpans, 5 metres at Leith, and 5·8 metres at the Forth Bridge. The increase in rise of tide from east to west causes the foreshore to be deeper for equal gradients in the higher reaches of the estuary. Full seas occur in late autumn

and early spring, when the available feeding-grounds are greatly enlarged at low water. The vertical range of the low-water line is much greater than that of the high-water line, so that the advantage gained in the lower zones of the beach during spring tides is more than lost during neaps. For the same reason, the diminution of tidal range in passing from spring to neap tides is not directly proportional to the loss in height of the tide, but diminishes at a greater rate. The tidal range during neap tides is, therefore, a factor of importance in controlling the numbers of a settlement. The area under observation was too small to allow of a comparative study of the effects of locally different tidal ranges. The occurrence of the fortnightly succession of highest tides between the hours of one and five has, in the day-time, an important bearing on the welfare of the Oystercatcher in relation to human activities.

All three divisions of a sea-beach recognized by Pearse in Massachusetts * occur in irregular sequence on the south side of the Forth. They are the rock-beach, sand-beach, and the mud-flat. The first and last are habitats of *Mytilus*; the second is of minor importance to the economy of the Oystercatcher. As the division was found to be a natural one, the rock-beach and the mud-flat will be taken, for comparison, as the two locally typical habitats of the Oystercatcher. Along the sixty odd kilometres of coastline from the Forth Bridge to Belhaven, Dunbar, there were found seven permanent winter settlements of the Oystercatcher. Of these, one is a purely mud-flat station, two are mud-flat, rock-beach stations, while the remaining four are confined to rock-beaches only. In addition, two large *Mytilus* stations, not permanently occupied by Oystercatchers, were under observation. In the next section an account is given of the general features of the stations examined, in order to afford some idea of the nature of the ground in this locality.

2. *Mud-flat Habitat*.—Estuary of the East Lothian Tyne. The river flows into a small estuary locked from the North Sea by a long sandbar. The substratum consists of sand in the outer and marginal parts of the estuary, and of a fairly firm mud in the centre of the area, through which the channel flows. Weed is not common. There is a plentiful supply of Mussels of

* 'Rev. Knowledge,' 1915, p. 59 (no reference given).

good size on the mud. The central area slopes more steeply downwards where it borders the channel so that, when the tide is out, the birds can feed without being readily seen from the land. The feeding area is more than 150 metres from the grass. The central portion of the sandbar does not cover at high water, when it is used as a refuge. There is a moderate stock of Oystercatchers.

3. *Rock-beach, Mud-flat Habitat.*—A. *Aberlady Station.* Aberlady Bay is a large sandy and muddy flat, intersected by the channel of the Peffer Burn. The bay may be divided into three transverse zones. The highest zone is rarely visited by Oystercatchers. The middle zone, west of the channel, is a mud-flat. The mud is tenacious and does not shift readily. The greater part of the area is covered with Mussels of a good size, and is more than 150 metres from the nearest danger point. Eastward of the channel the conditions are, at first, similar to those of the western part of the middle zone, but they soon change to a sand-beach, which extends to the eastern high-water mark. The lower zone is composed mainly of sand-flats, which become extensive as the bay widens towards its outlet. In the middle zone, with the exception of the steep borders of the channel, the substratum lies mostly above mean-water level. In Gosford Bay is a large smoothly contoured area of volcanic rock. *Mytilus* is abundant here and of fair size. The mud in the lower part of the bay is apt to shift and bury the lower lying Mussels. East of these rocks a sandy bay is a factor of some importance. The rocks at the east and west ends of Gosford Bay are loaded with *Fucus*. At the east end of Longniddry Bay is a stretch of low-lying volcanic rocks, well provided with Mussels. These rocks, though lying rather near the high-water mark, are covered early by the incoming tide. The volcanic rocks east of Gullane Point have considerable supplies of Mussels. These rocks alternate with sand-beaches. They lie close in to the shore generally, and through their conformation are easily approached. One part extends far out into the sea, but the non-tidal portion runs nearly as far, and is well adapted for stalking. The area is visited irregularly by Oystercatchers. The refuge for this station is nearly five kilometres distant (Eyebroughty). The resident stock is, perhaps, the largest in the Forth. The birds

have a special tidal range of movement. Beginning at low water at the western-most feeding-place, they move eastward by stages, according to the tide, each of the three main feeding-places being adjusted to a certain state of the tide, and end towards high water at the eastern-most part of their range—on the refuge of Eyebroughty. The sequence is reversed on the ebb.

B. *Drum Flats Station.* The two previous examples of the mud-flat habitat are enclosed in small estuaries, debouching in the one case into the North Sea, in the other, into the estuary of the Forth. The Drum Flats, now to be described, border the Forth itself, and form on the southern shore the lowermost part of the continuous mud-beaches of the upper estuary. The mud is light and shifting in places, more tenacious in others. Weed is luxuriant. Bordering the channel of the River Almond the mud is firmer, and large areas afford an abundant and good supply of Mussels. The feeding area lies more than 150 metres from the land. A large stock is resident in winter. A range of tidal volcanic rocks lying to the west of Granton Harbour and well off shore is covered with Mussels in the absence of weed, and is much visited by the settlement. Cramond Island, lying at the mouth of the Almond Channel and close to the principal feeding area, is inhabited. The Oystercatchers do not resort to it. The refuge is on the Islet of Inchmickrey, lying on the middle bank of the Firth of Forth. The exposure is not severe.

4. *Rock-beach Habitat.*—Of the four stations of rock-beach habitat coming under observation, one (Eyebroughty) will be described in some detail, and only the factors by which the others differ from the Eyebroughty station will be mentioned. In the Eyebroughty station a long tidal reef, lying to the west of Eyebroughty, and about 450 metres from the mainland, provides quantities of *Mytilus*, for the most part of small size. The settlement feeds here a good deal, but the foothold is only moderately good, and in storms the reef is wave-swept. Near Cheese Bay there are two large bosses of volcanic rock lying well off the land. They are crowded with *Mytilus* of small size, and are visited daily. At the east end of Redhouse Bay there is a flat, low-lying rock forming a horn to the bay. The outer part carries a moderate stock of small Mussels. Part of the

ground is under 150 metres from cover. Here the birds are irregular visitors, mostly in the mornings and in bad weather, if tides are suitable. West of Weak Law is a bed of shale abundantly supplied with shell-fish of various kinds and suitable size. It lies more than 150 metres from cover. The rocks at Weak Law are poor in *Mytilus*, but rather rich in *Modiolus* and *Patella*. They run well out to sea. Approach, however, is easy owing to the lie and nature of the rocks. They are seldom visited. Further east lies a great mass of lava, portions of which are permanently cut off from the main mass by water. *Mytilus* is abundant but small. The birds visit these rocks frequently, and are here difficult to approach. The western part of Fidra Brig (lava) provides quantities of *Mytilus* and *Modiolus*. The rock is hummocky, and the feeding area is not too far from the mainland. The birds visit occasionally and can be stalked with comparative ease. Eyebroughty Brig lies more than 360 metres from the mainland, opposite the central portion of the shore area. It is used as a refuge. The stock of birds is small.

The Seacliff settlement is small. The features are similar to those found at Eyebroughty, but the depth of foreshore is less, and there is a severe exposure to storms. In some places the *Mytilus* stations are within 150 metres of the grass. A long volcanic reef, dry at high water, lies well off shore, is used as a refuge, and probably also as a feeding-ground.

The Lamb station is peculiar in that the islet forms both the refuge and the principal feeding-ground. Supplies are also drawn from the Longskellies and from skerries off North Berwick. The exposure is fairly severe. The feeding-grounds are difficult of access. The stock is small.

The small Cuthill settlement lives in unusual surroundings. A low-lying, slabby rock centres a small bay of gravelly sand, and lies about 180 metres from the coast road. A small harbour, a tile-works, a coal-pit, and a number of miners' rows partially surround the locality, which is in itself rather difficult of access, and therefore not much disturbed. The rock has a good supply of *Mytilus*. A volcanic dyke, dry at high water, lies off shore, and is used as a refuge and a *Mytilus* feeding-ground.

Two large *Mytilus* stations of rock-beach habitat occur at

Redhouse and at Seafield. Neither has a resident stock of Oystercatchers, and visits are irregular, occurring mostly in the early morning. At the former station the rocks descend abruptly to a sand-beach, and have little breadth. The larger sizes of Mussels preponderate, but lie well within 150 metres of the grass. In the latter, the eastward rocks have a similar character. Towards the west the rock-beach is prolonged out to sea by a succession of more or less isolated reefs carrying plenty of Mussels. The foreshore here is much disturbed. Neither of these areas has a refuge within ordinary range.

III.—DISCUSSION OF THE WINTER ENVIRONMENT.

Summing up the conditions common to all the occupied stations of the rock-beach and mud-flat habitats on the south shore of the Firth of Forth, we have the following :—A body of seawater; *Mytilus* in sufficient quantity, of a suitable size, in accessible situations, and at or more than 150 metres from the nearest danger point; a place of refuge which can be resorted to for safety during the period of high water, and at other times when the feeding-grounds are disturbed.

Resort to a place of refuge at certain times is a local adjustment to human interference. In the early part of the winter, when disturbance is infrequent, the birds rarely leave Aberlady Bay during diurnal high water, and if they do, it is with manifest reluctance. At high water they collect at one part of the shore, which is a constant for the purpose, and takes the place of the refuge as the headquarters within the territory. As the winter advances, the birds are more liable to be driven from the high-water mark. They then proceed to the refuge. Later still, in the daytime they "anticipate" disturbance by not coming in to the high-water mark at all during spring tides, and proceed to the refuge one or two hours before the time of high water. But throughout the whole winter, during the diurnal high water of neap tides, and the nocturnal high water of all tides, the birds remain at the headquarters in the bay. In the former instance, the low gradient of the beach enables the birds to remain on the high-water line beyond the range of gunfire. In little disturbed localities, permanently occupied winter stations occur which have no special refuges. The Oystercatchers which feed

on the Mussel-bank at the mouth of the River Awe, or the Mussel-scalps on lonely parts of the coast of Northumberland, have no distinctive refuge. They pass the time of diurnal high water on a constant part of the high-water mark. When disturbed, they proceed to little-frequented fields in the vicinity.

Oystercatchers show a decided preference for Mussels about 3·5 cm. in length. Why, has not been determined. Probably Mussels ranging closely about this size provide food in due proportion to the amount of labour required to get it. When the Mussels are larger, too much energy is needed to open them; when they are smaller, too many have to be opened, and the more fragile shell is apt to be crushed into the body of the mollusc. In this condition they are commonly refused.

The situation of the feeding-ground at or more than 150 metres from the nearest danger point is also an adjustment, probably local, to human intervention. In the Firth of Forth large areas of Mussel-scalp, providing an abundance of food, lie too near the shore line owing to steepness of the gradient. These areas are seldom visited. When they occur near to or within a permanent winter station, they are visited only at night or in the early morning.

To most of the permanent stations in the Firth there are attached areas of wet sandy beach, generally lying close to the feeding-grounds. These areas are much used, especially after a spell of feeding, for the purpose of crowding together, preening and resting, and, in fine weather, for the sunning reaction. The presence of such an area is, however, not essential, for the condition is absent from the Lamb territory. The habit is not protective during the resting periods. The birds are very conspicuous while on the sand, whereas on the rocks or on mud, crowded with Mussels, they are often hard to distinguish. Crowding together appears to form an essential part of the habit. Owing to the irregularities of rocky areas and of mud-banks, dotted with clumps of Mussels, crowding can rarely be possible in these localities. A smooth expanse of sand is better adapted to the purpose. It is also possible the soft wet sand is a necessary condition of the response.

Along the Forth the Oystercatcher has few enemies, and even the depredations of man—the most important destructive

agent—have no apparent effect in the course of the season on the general mass of the birds. Comparative immunity is due to the wildness of the birds and to their extreme sensitiveness to the existence of potential dangers. Man, however, is himself an important condition of the environment. He has modified the local habits of the birds by leading to the establishment of refuges, and by limiting the number and size of the available feeding-grounds. The Peregrine is able to produce little more than a momentary commotion in the ranks of the Oystercatcher: no attack has been seen. The Sparrow-Hawk and the Kestrel are ignored. The Great Black-backed Gull is treated with some respect. The two species have not been seen very close together. No attack has come under observation. Throughout the winter the number of Oystercatchers in the area is not appreciably diminished, though there must always be the loss of a few.

The activities of the Oystercatcher are controlled in winter by the rhythm of the tides. The birds are slavish followers of the tideline. For about four hours during each period of high water the main supplies of food are inaccessible. As a consequence, the periods of rest and activity are determined by the tidal rhythm. There is also a rhythm of longer wave length dependent on the fortnightly oscillation of the tides. This rhythm is never manifest in early winter, but gradually appears in consequence of human interference. It shows itself by day, as a "reflex anticipation" of the greater height of the high water of spring tides. It is not due simply to the tide carrying the birds above the high-water mark of neap tides, for restlessness and the departure to the refuge occur long before the neap high-water mark is reached by the tide. The basis of the reaction is evidently complex.

It is doubtful if a true tidal habit, diurnal or bi-weekly, is ever established. No observations on this matter are possible on the shore. I have so far seen no sign of a tidal rhythm in the habits of the birds when they begin to move up the rivers where they breed. Diurnal rhythm is obscured in the winter environment of the Oystercatcher, the activities of the birds being regulated by the movement of the tides. Search for food continues after dark, and is evidently carried on much as in



daylight. The accumulation of excrement on the high-water mark of the night tide, when the latter reaches its highest point hours after darkness sets in, is sufficient evidence of night feeding, for the process of digestion and excretion in the Oystercatcher is extremely rapid. Darkness, however, has a restraining influence on nocturnal flight; for, whenever high water occurs in Aberlady Bay near the time of sunset, the birds, if disturbed, show unwillingness to fly to the refuge on Eyebroughty, and remain over the bay, prosecuting an aimless flight until the tide ebbs far enough to enable them to alight out of range. Further, by night the birds remain, so far as known, in the central parts of the feeding-grounds. They extend their feeding excursions to the more distant parts of their territory only in bright moonlight.

In winter the influence of variations in climatic conditions is mainly an indirect one, for the Oystercatcher is remarkably hardy, no extremes of temperature or humidity likely to occur in the Forth area seeming to have any harmful effect. Torrential rain inhibits all except compulsory movements, until the need of satisfying hunger becomes paramount. Really hard weather increases the food activities, at the same time suppressing all motor signs of the pleasure state. The appearance of the birds, however, never suggests a condition of "physiological misery." With the coming of the new year, moderately cold weather, if associated with bright sunshine, is favourable to early nuptial developments, while the mild weather of autumn brings out "autumnal genital activities."

Climatic control is exercised mainly over the available food supply. The Oystercatcher cannot open a Mussel when it is tightly closed, unless the byssal cleft can be reached, or the Mussel is small enough to be crushed. The former possibility rarely occurs; the latter seems to be dictated by necessity and not by preference. Extremes of temperature and moisture (bright sunshine, heavy rain, dry winds, hard frost) lead to an early and firm closure of the shell-valves of *Mytilus* soon after the Mussels emerge from the tide. The search for Mussels is then greatly restricted. The climatic aspect of the problem is important, for, so far from being a rare occurrence, weather conditions affect the food supply on almost every tide.

(To be continued.)

NOTES ON THE EGGS AND LARVÆ OF A SEA-BULLHEAD (*COTTUS BUBALIS*).

By H. N. MILLIGAN, F.Z.S.

A healthy female *Cottus bubalis* of about six inches in length, from Weymouth, was placed on January 23rd, 1915, in an aquarium at the Horniman Museum, where it lived until May 9th.

The Bullhead usually lay upon, or partly buried in, the shingle at the bottom of the aquarium, but at about 9.30 on the morning of January 28th I noticed that the fish was clinging by means of its spreading pectoral fins to the vertical rockwork at the back of the tank, and it remained there for several hours, certainly until 5 p.m. and possibly longer. Some time before 9.30 on the following day the fish moved away, and in a shallow depression amongst the rocks over which it had lain was a flattish mass of pale orange-coloured eggs. The mass, which was roughly oval in shape, was about two inches in length and one and a half inches in breadth. It was ascertained later that the number of eggs in the mass was nearly two thousand, and at its deepest part the mass was about twelve layers of eggs in thickness. The average size of the eggs was 1·5 mm.* The eggs adhered together at laying, but they became harder and more firmly attached as the days passed. Not more than a quarter of the eggs in the mass developed.

The day after laying, the Bullhead returned to the egg-mass, and remained on it for about two hours, but it was impossible

* J. T. Cunningham, "On Some Larval Stages of Fishes," 'Journal Marine Biological Association,' N. S. 2, 1891-2, p. 72, gives the diameter of the eggs examined by him as 1·7 mm. E. W. L. Holt, "On the Eggs and Larval and Post-larval Stages of Teleosteans," 'Scientific Transactions of the Royal Dublin Society,' vol. 5, ser. 2, 1893, p. 27, observes that he found the eggs larger in some clutches than in others, the largest being 1·88 mm. Fabre-Domergue & E. Biétrix, "Recherches Biologiques applicables à la Pisciculture Maritime," 'Annales des Sci. Nat.,' vol. 4, 1897, give the diameter of the egg as 1·5 to 1·6 mm. E. Ehrenbaum, "Eier und Larven von Fischen der Deutschen Bucht. 3. Fische mit festsitzenden Eiern," 'Wissenschaftl. Meeresuntersuch. in Kiel,' N. F., Band 11, 1910, p. 137, gives the size of the eggs as 1·51 to 1·76 mm.

to see whether she laid any more eggs.* Beyond this she showed no interest in the eggs, nor did she pay any attention when they were interfered with. It may be pointed out that no other Bullhead had been in the aquarium, and that no fresh sea-water had been introduced into the tank for some weeks. It would therefore seem that this female had been fertilized in the sea, from which it had been taken six days before the eggs were laid.

On the afternoon of February 17th (that is, on the twenty-first day after laying) the eggs were transferred to another tank, in order to guard against the danger of the coming larvæ being eaten by the several individuals of the Goby (*Gobius paganellus*) and the two individuals of the Prawn (*Palæmon serratus*) which lived in the same aquarium, though neither Gobies nor Prawns had touched the eggs. Two hours later the larval Bullheads began to break away from the egg-mass, and hatching went on at intervals during that day and the next. Hatching was possibly hastened by this removal, for according to Ehrenbaum the eggs are laid in March and April and hatched six to seven weeks later.† Less than a quarter of those which had arrived at a stage when they were able to escape actually hatched from the egg, so that out of nearly two thousand eggs only about a hundred larvæ were obtained. For several days before hatching, the larvæ could be seen making occasional sudden movements within their egg-envelopes, and their eyes, which were of a bright metallic blue or green colour by reflected daylight, or a bright copper colour by the light of the electric lamp above the aquarium, were very conspicuous. Each transparent larva, which was 4·5 mm. in length at hatching,‡ had a protuberant abdomen, long tail, and two large membranous semicircular pectoral fins.§ The larva could easily be detected in the water

* M'Intosh, "Remarks on the Eggs of British Marine Fishes," "Nature," vol. 34, p. 148, says that, so far as was known, deposition of the eggs is performed rapidly in the *Cotti*. † *Op. cit.* p. 137.

‡ The length of the larva at hatching is given by different authorities as follows:—Cunningham (*op. cit.* p. 72), 5·7 mm.; Holt (*op. cit.* p. 27), 5·71 mm.; Fabre-Domergue & Biétrix (*op. cit.* p. 168), 4·5 to 5·5 mm. Ehrenbaum (*op. cit.* p. 138), 5·5 to 5·8 mm.

§ Figures of the newly-hatched larva are given by Cunningham (*op. cit.* plate iv.), Holt (*op. cit.* plate v.), and Ehrenbaum (*op. cit.* plate iii.).

by its bright eyes and the saddle-shaped mass of black pigment in the abdomen.*

Immediately it had jerked itself free from the egg-mass, each larva began to swim vigorously in a vertical, or nearly vertical, position at, or close to, the surface of the water by rapid vibrations of its tail. None of the larvæ pursued a straight course through the water, their movements being exceedingly irregular. One of them, for example, went round and round in circles of about half an inch in diameter, at the same time revolving rapidly on its long axis. Several of them were to be seen moving round in such a way that their tails described small, while their heads described larger, circles. None of them moved tail foremost. After a few minutes of swimming a larva would cease to move its tail, and sink to the bottom to rest for two or three minutes, and then it would give a convulsive jerk and begin to swim again. These observations were made on the larvæ which were in an aquarium, containing nearly thirty gallons of well-aerated and constantly-moving sea-water, standing in a fairly dark spot. The behaviour of a dozen of the larvæ placed in a white enamelled bowl containing about a gallon of still sea-water in the direct light from a window was of a similar character. The larvæ in the larger tank seemed always to be fairly evenly distributed throughout the tank, and there was no tendency in the larvæ to congregate behind the glass front.†

At the beginning of the second day after hatching, the larvæ seemed able to keep a more even course through the water, and to swim with greater vigour. If the motions of its tail ceased, however, a larva would immediately turn head downwards and fall slowly to the bottom, where it would usually lie for a few minutes, its little eyes shining so brightly that it was not at all difficult to detect them amongst the shingle of the bottom. After several ineffectual attempts I was able to time one which swam obliquely upwards through an almost straight course of about fourteen inches immediately behind the glass front of the tank; it took fifty-four seconds to swim this distance, so that

* Cunningham (*op. cit.* p. 73) points out that the pigment is not in the skin but in the peritoneum over the region of the stomach and rectum.

† Fabre-Domergue & Biétrix (*op. cit.* pp. 174-9) describe the attraction of light on the larvæ of *Cottus bubalis*.

the larva must have travelled at the rate of about one inch in four seconds.

At the end of the fifth day after hatching the average length of the larvæ was 5·5 mm., and their ability to keep a straight course through the water was still more marked. There seemed also to be a decided tendency towards swimming in a horizontal position. The larvæ appeared, however, to be almost helpless, and when touched with the point of a pencil made at most a little jerk away from it. Repeated touches with the point of a pencil merely resulted in repeated horizontal jerks, and did not cause the larvæ to seek safety by diving deeper into the water; nor did agitation of the water by a pencil held close to any larva seem to alarm it.

On the sixth and seventh days the larvæ began to give indications of inability to swim vigorously, and to lie for longer and longer periods on the bottom. They now began to die off rapidly, the last one dying on February 26th, that is, on the ninth day after hatching began. Those placed in the bowl of still water did not live beyond the end of the second day.

During the night of February 20th-21st (*i. e.* on the twenty-fourth day after laying, and on the fourth day after hatching began) the Bullhead laid another, and smaller, mass of eggs. The number of eggs in this mass was not more than eight hundred, the great majority of which developed so far as to be ready for hatching, although only about thirty actually hatched out, the remainder dying at this stage. The egg-mass was transferred to a fresh tank on the morning of March 15th (on the twenty-third day after laying), and on that day and the next hatching went on, as it had done when the first mass was removed. None of the larvæ from this second mass lived beyond the end of the fourth day. It may again be pointed out that there seemed to be no possibility of the eggs being fertilized in the aquarium.

Would the Bullhead have laid the second mass upon the first if the latter had not been removed? It seems probable that it would, because, as already mentioned, the fish had returned to the first egg-mass on the second day and remained on it for about two hours. The water in the tank was fourteen inches deep, and the first mass of eggs was laid in a situation in which

its upper edge was three and three-quarters of an inch from the surface of the water. The second mass was laid, in another part of the tank, on a little ledge of rock about three-quarters of an inch from the surface.*

It was pointed out above that the Gobies and Prawns did not touch the eggs, but on February 8th (on the eleventh day after laying) an *Asterina gibbosa* was observed upon the first egg-mass, and another of these asteroids was found on it on the 9th. There is no doubt that one at least of the *Asterinæ* was attempting to feed upon the eggs, because, when it was quickly and gently lifted up, its stomach was found to be in the everted condition. It seemed desirable to ascertain which animals in the different aquaria would feed upon the eggs of the Bullhead, and the following experiments were made, immediately before the time of hatching of the eggs.

A third *Asterina*, which was given a small group of the eggs, fed upon them, but a fourth refused them. A hungry Common Starfish (*Asterias rubens*) took them, but a recently fed individual did not. Eggs thrown to six hungry Wrasse were seized before they reached the bottom of the tank, but all of them were hastily disgorged again.† Three individuals of the Blenny (*Blennius pholis*) treated the eggs in the same way. A Hermit-Crab (*Eupagurus bernhardus*) would not touch them. A Long-legged Spider-Crab (*Stenorhynchus phalangium*) picked up a group of the eggs and held them to its mouth, but did not eat them. Three females of the Four-horned Spider-Crab (*Pisa tetraodon*) refused them. A large female Fifteen-spined Stickleback (*Gasterosteus spinachia*) followed and closely examined them as they fell through the water, but did not take them into its mouth. Four individuals of the Purple-tipped Sea-Urchin (*Echinus miliaris*) certainly worked upon two groups of the eggs with their teeth, but it was difficult to see with what result.

Two of the larvae of the Bullhead, on the second day after hatching, were put into the aquarium containing the Fifteen-spined Stickleback and were immediately swallowed by the latter.

* Holt (*op. cit.* p. 27) mentions that at St. Andrew's eggs were frequently found on perpendicular ledges so as to be wholly or partially out of the water at low tide.

† The same Wrasse eagerly swallowed and retained eggs of the Common Spider-Crab (*Hyas araneus*) about a week later.

NOTES ON THE TREE-SPARROW IN DONEGAL.

By THE REV. J. M. McWILLIAM.

In the 'Irish Naturalist,' August, 1907, Mr. Robert Patterson published an account of a small colony of Tree-Sparrows found by me that summer in the south of Co. Donegal. I only had these birds under observation for a couple of weeks, and had not the opportunity of going back to the district in the nest season till last June, nor could I get any information as to the continued existence of the colony during the interval of eight years.

In 1907 I found four nests in all, which I believe represented two or three pairs of birds. The nests were quite close to one another, as is shown in the accompanying diagram, and I could find no Tree-Sparrows anywhere else in the neighbourhood, though I was constantly in suitable places for a few miles on each side.

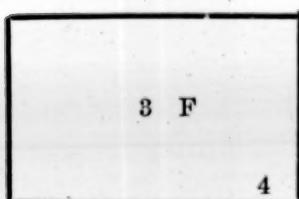
There was one remarkable fact in connection with this colony, to which I shall refer again later. In order to leave no room for doubt about the identification of the birds, I took a pair of Tree-Sparrows with their young, and I subsequently heard from Messrs. Williams, of Dame Street, Dublin, that on examination both of the old birds were found to be males. It was as certain as it could be that both of these males were partners in the same nest (1) (see diagram). I had them under observation immediately beside the nest for some time before I reluctantly shot them. At the same time there was a female sitting on another nest not very far away (2), and I believe that she was the female belonging to this brood. There were no other Tree-Sparrows in the immediate neighbourhood, and I never saw more than two Sparrows feeding the young in the first nest. I assume that the limited number of birds in the colony led to this unusual incident, and that the female left the first brood to lay again in another nest. At least this suggested itself to me

as a possibility; but of the fact of there being two males feeding the one brood of young there was no room for doubt.

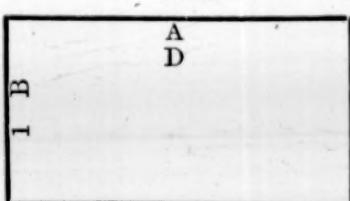
Since 1907 the only information that I could get about this colony was from a reference in the 'Irish Naturalist' (October, 1909, p. 226), to four Tree-Sparrows having been seen near Ballyshannon, a few miles from the place where I found the birds.

Then in July, 1913, there was a very full account published in 'British Birds,' by Professor C. J. Patten, of a much larger

D—GARDEN.



R—GARDEN.



HOUSE.



HOUSE.



About three hundred yards.

S.
↓
N.

Sea front.

The broad lines represent stone walls about ten feet in height. The birds breed in holes six or eight feet from the ground in these. The figures represent the nests of 1907. The capital letters represent nests of 1915. "3" and "F" indicate presence of breeding birds, exact nesting site not discovered. The nests "C" and "E" I believe to have been in the nesting-hole that "2" was in. The distances from left to right are larger than indicated.

colony of Tree-Sparrows found by him on Inishtrahull Island, to the north of Co. Donegal. It was not till June, 1915, that I was able to revisit my colony and get the information about it which I now give. I was naturally very glad to find that the colony was still in existence in precisely the same locality, and that the birds had slightly increased in number. I believe that the nests that I found in 1907 represented, as I have said, two or three pairs of birds. The nests that I found this June,

and the adult birds that I saw in different places, must have represented four or five pairs. In each year I believe that I had practically all the breeding birds under observation.

I give the notes from my bird diary. The accompanying diagram shows the different nests to which I make reference in it.

June 6th, 1915.—I went into R—garden and soon saw a pair of Tree-Sparrows feeding their young in a nest (A) in the south wall. I watched the birds at intervals through the day. The young are about half grown. The nest is in just another such hole as the nest that I found here before (1) was in, perhaps fifty yards away from it.

I then went to the wall where I had found the other nest (2) in 1907, and was very much surprised to find a nest there also (C), possibly in the very hole where the birds nested before. Indeed I think that there is little or no doubt about the hole, as I had taken out a stone to get to the nest, and then replaced it. There were young birds in the nest, not very long hatched. I did not see the old birds well enough to identify them with certainty as Tree-Sparrows, but I have no real doubt about them. Later in the day I went over to D—garden where I had seen a pair of Tree-Sparrows with young in 1907 (3), and I found a pair of Tree-Sparrows there also. It is very surprising to find just the same number of birds breeding in just the same situations as in 1907. I did not go into this garden after these Sparrows, but I saw them at a pretty close range, and they were obviously looking after young.

8th.—I went to R—garden. I saw a couple of young Tree-Sparrows being fed on the top of the wall. I do not think that they could be from the nest that I found in the garden (A), as I went to this nest and saw young birds still in it, very well feathered but hardly ready to leave yet. I went to the other nest (C) in the wall of the field, and identified one of the parent Tree-Sparrows with certainty.

I saw one or two nests of the House-Sparrow, but there are certainly not as many of these round the house and garden as there used to be before I found the Tree-Sparrows.

In the afternoon I went out to the garden again. There are certainly more than one pair of Tree-Sparrows round this garden. I had three adult birds in sight at one time.

The Sparrows are very well worth watching. They are far more alert and bright than House-Sparrows. They do not in the least mind my watching the nests from a distance of thirty yards or so, but I can never get very close to the birds. Except by the note, which is very distinctive, it would not be easy to identify them with certainty without a glass.

10th.—I went to R—garden. The young Tree-Sparrows in the nest in the south wall are about ready to leave. I saw one being fed at the entrance to the breeding-hole, and I was not certain that some had not actually left. I saw a Tree-Sparrow going to a hole (B) in the east wall, and went over and found the nest. It was of the usual type and contained five eggs, four with a great deal of dark brown marking and the other with a light ground and some dark markings. The eggs were as small as usual, much smaller than those of the House-Sparrow. The nest was immediately beside the hole where I found the first nest in 1907.

13th.—I went to the Tree-Sparrow's nest in the wall of the field (C). The young are nearly ready to leave.

14th.—The young Sparrows in nest (C) are ready to leave. One of them flew a considerable distance from the nest.

22nd.—I saw a Tree-Sparrow leaving the nesting-hole (A) in the south wall of the garden, that the young birds left a week ago, and when I went over I found that new nesting-material had been brought to the nest. I had wondered why I did not see any old nests of other years round the walls, but apparently the birds are using the same holes repeatedly.

23rd.—There is new nesting-material (E) in the nest (C) in the wall of the field. The birds are certainly using it again. I saw the old birds near the nest, still with the young ones round them. I went into D—garden, and saw a pair of Tree-Sparrows that had obviously got a nest in it. One of the birds was carrying a feather. Both came quite close to me and showed anxiety. I think that there is only one pair (F) there.

25th.—The Tree-Sparrow's nest (E) in the wall of the field has one egg to-day. The birds have added considerably to the nest. They have even used a little green grass. These Sparrows do not seem to mind my being often at the nest. I handled the small birds of the first brood repeatedly, and have been at the

nest several times since they left. A stone has to be removed, too, from the entrance to the nest before it can be examined. There has been a very short interval since the first brood was reared. The young were in the nest, though ready to leave, on June 14th.

26th.—The Tree-Sparrows are still adding material to the nest in the wall of the field, though two eggs have been laid.

28th.—Four eggs in Tree-Sparrow's nest to-day.

On June 28th I had to leave this place.

In his paper in 'British Birds,' Professor Patten raised the question again as to whether this colony could have existed before I found it in 1907. I had stayed in the house, beside which the colony was, during a considerable part of the nest seasons of the two preceding years, and had naturally been frequently in the garden, so I can hardly believe in the possibility of the Tree-Sparrows having been there then. I know how easy it is to overlook birds that one does not expect to find, and in 1907 I had certainly been beside the colony for a week or two before I discovered it; but on the other hand I recognized the birds the first time that I happened to go to the garden; and even before I saw them there I had already found another nest (2) about one hundred yards away, which eventually turned out to be a Tree-Sparrow's, and was keeping it under observation. During practically the whole of this week I had been working at some other birds some miles away, and had taken it for granted that there was nothing to be found in the garden in which I had often been in other years.

Also there had been a large colony of House-Sparrows in the garden, which has much diminished in numbers since I first found the Tree-Sparrows.

But the most interesting evidence for the colony having been newly founded lies, in my opinion, in the fact to which I have referred, of the two males breeding with one female. In the 'Irish Naturalist' for June, 1908, Mr. C. B. Moffat brought forward a number of facts that suggest that the struggle for existence and reproduction amongst birds takes the form rather of a struggle for breeding ground than for the possession of females. His argument was that the female was easily obtainable by a male which had established its claims to a

suitable breeding space. If that be so, one would expect that in a new colony, which had unlimited room for expansion, much of the sexual rivalry amongst the males would disappear. Certainly Mr. Moffat's theory, if I have given it fairly, would find a kind of support from the incident that I discovered. It certainly seemed strange that two males of so active a species as Tree-Sparrows should live so harmoniously together, unless there were very exceptional circumstances, such as an extreme scarcity of birds in an entirely new and isolated colony.

Of course, the fact that the numbers in the colony have since increased forms the most substantial proof that the birds only began to nest here in 1907.

I was interested to see how clearly the young Tree-Sparrows showed the distinguishing marks of their species even before leaving the nest. One which I examined at that stage showed quite distinctly the brown head and black cheeks, and the double bar on the wing. Unfortunately I have not been able to spend a complete nest season in this locality, so I do not know how many broods are reared by each pair, but the dates that I am able to record would suggest that as many as three broods may be reared in the same nesting-hole in a season. Even assuming that two broods only are usual, it is strange that since the colony has held its own, it has not increased at a greater rate. I have worked at birds over most of this district to the south of Donegal Bay, and have been on the look-out for other Tree-Sparrows, but have never seen any. It is hard to believe that they have not formed, or are not forming, other colonies between Inishtrahull and Donegal Bay, or along the Leitrim and Sligo coasts. A census of the Sparrows of both species along this coast would be interesting. I have seen House-Sparrows at every point between Ballyshannon and Grange, in Co. Sligo, but have never seen Tree-Sparrows, except in this one colony, which apparently only extends for a few hundred yards.

A DIARY OF ORNITHOLOGICAL OBSERVATION MADE IN ICELAND DURING JUNE AND JULY, 1912.

BY EDMUND SELOUS.

(Continued from p. 174.)

IMMOBILITY must be as protective as protective coloration, and perhaps more so, for that would be an unfit species whose eye was deceived by coloration after it had detected motion in one suited to its needs. I have spoken of the immobility of the Golden Plover on its nest. To-day, for the second time, I watched a Red-necked Phalarope under the same circumstances. Some turves have been cut and piled up on each other, almost on the very place where I sat before. I got up upon the highest of these heaps—some three or four feet from the ground—which made a comfortable seat. Almost from the first, my glasses detected something which I first thought was, then was not, and finally was—but not quite certainly—the head of the sitting bird. There was a curvature which seemed quite perfect both for head and neck. It was indeed, all along the outline, of the grey bleached shade of a withered blade of grass, of which there were many all about, but still why had it that curvature? None of the others had. Why, too, was it always motionless though there was a wind—sometimes a little gust of wind—when other blades round about it could be seen to move? So much for the outline, but beyond that outline, or, rather, enclosed by it, I could see distinctly coloration and substance which was not to be explained by any of the scant vegetation—scant, at least, in kind—round about. There was a dark, defined mark on the nape side of the neck, and two others, if I remember, on that of the throat. There was shape too—the required shape—more of it I mean—that of the throat and chin with a suggestion of the beak—just beginning—the rest being hidden. Still the colour of the head and neck outline so

exactly resembling a withered blade of grass—identical with every other one—that however was all as required on protective principles, so ought not to have puzzled me. Taking it all together I felt sure it must represent a bird. But if so its immobility was extraordinary, and I determined to test it. Setting the glasses on the small expanding cane seat of my walking-stick camp-stool I watched the appearance steadily, for half an hour, but could detect no movement. It seemed almost impossible that a bird of any sort, be it never so sitting a one, should not move its head once in that time, but I remembered the Golden Plover, as to which there was no doubt. After this, Whimbrels took off my attention for another ten minutes, but when I looked again, there was the bird's head and neck—outline and shading—just as, and just as motionless as, before. Now I got down from my mound, and fixing my eyes as much as possible on the spot where they had so long been fixed, walked slowly towards it. Nearer I got and nearer, but saw no bird (it was my own eyes now, not the glasses), nearer still, nearer at last than when I had seen it distinctly before there, several days ago, much nearer. The nest then was empty—yes, undoubtedly empty—still for an absolute proof, I thought I would make the few remaining paces, and did so, and off flew the bird, from the very precise spot, as far as I could judge and locate it, where I had located it all the while. Here was a triumphant resolution of all my doubts, of all my laudable precautions against undue assurance. It had been there all the time, just where a blade of grass had seemed to be. I had only to go back now, reclimb my mound, fix the glasses as before—which would be easy, for the whereabouts of the nest was marked—and the absence of any such blade having the curvature of a bird's head and neck would prove the similitude up to the hilt. All which I did, and looked—and there was the curved blade of grass !

The bird had sat somewhere else, and invisible, all the time, whilst I had only looked at an imagined something, and now the whole simulacrum had “softly and suddenly vanished away.”

And yet no, this view can hardly be maintained, in fact is untenable, for, if the curved blade of grass remained, nothing else did that had helped to make the bird—the bird that was on

the nest, which was and is precisely in that place. The deepenings of colour or shade, the soft, undefined outline of throat and chin, the beginning of the bill, all were gone. There was no possible making out of a bird now, from the curved grass-blade alone. However bird-like its curve was, clearly it was only a grass-blade, "merely that and nothing more." The rest had been there, had vanished, and *pari passu* with that evanishment the actual bird was flown. So I reasoned. I could not and I cannot persuade myself that the chance shape of a grass-blade, simulating the not very complex outline of a bird's head and neck, had made me imagine all the rest. It was not a case of aroused expectation, which, moreover, I have always found fail me. My theory was, and is, that there had been a chance combination between bird and grass-blade, in which case—and I feel pretty certain it was the case—the bird's immobility was astonishing, and, now I come to think of it, so was that of the grass-blade. Why it should not have moved, though there was always a wind, I really cannot explain (since it did not appear to be in any way sheltered, and elsewhere there was movement enough), but move it did not. The bird's immobility, however, was voluntary, and it is a little curious that this form of protection, equally, there can be no doubt, the product of natural selection with that of a dull or assimilative colouring, should have aroused hardly any attention—at least in the higher vertebrates—whilst the other has been so taken up that no one seems to know when to put it down. Yet I cannot doubt that, in the degree of its development, it is the more protective of the two. There is no species so quietly coloured as not to be seen when it moves, and none, probably, too bright to escape observation by keeping still.

My first watching of this Phalarope on the nest was on Friday (21st). I then saw it sitting distinctly, as I came close up—perhaps within six or seven paces. The day before (I think) when I had marked the nest, I saw nothing of the bird, so that if it had been on it, it must have walked away—not flown. Remembering this, but not before I had turned and got some distance on my way back, I thought I would test it now, and so walked right up to the nest, which I found empty, not having seen the bird again. It is not very likely that it went off

whilst I was walking away, having let me come so close without moving, so it may either fly or steal from the nest. As incubation advances it probably sits closer, and this strengthening of the brooding instinct might overcome a feeling of caution which would induce it otherwise to retreat as unobtrusively as possible, but I find it difficult to believe that the bird has really this prudent idea in its mind.

It was about 7.30 p.m. (to-day) when I got back to my place, after seeing the Phalarope fly off, and I watched the nest for another three-quarters of an hour before leaving. The bird had not returned during this time.

June 26th.—Started again, on the ponies, after breakfast, and pitched the tent on the shores of a quiet bay of a lake which we had passed travelling up from Reykjavik, in which I had noticed a good many of these little Phalaropes, which are here quite common. They now seemed less numerous, but there were still a fair number, and, when Sigardsson had ridden off, I set myself seriously to observe their habits. They swam about on the still waters of the bay—it is now a calm, still evening, after deluges of rain—in what, at first, seemed an aimless manner, continually altering their course and making sudden little tacks and jerks, all with a funny little nodding motion, as if they were Moorhens “in little.” It soon became apparent, however, that they were feeding, and the only question then was on what. Nothing was visible, but these as well as all the actions, could be explained on the supposition that minute insects were the objects of pursuit, and, since Mosquitos * were everywhere, it seemed likely that they were the staple. As I continued to watch I observed some little peckings in the air, and once there was an aerial pursuit on the part of two of the birds, which presented the counterpart, during the short time it lasted, of their movements in the water. Soon a pair of Phalaropes, and then a third, came down quite close in front of my tent, and, swimming to the bank, began to hunt something right under it, then, coming out, any little patches of weed were investigated, as well as rocks jutting out from the shore, the birds sometimes walking over these. Wherever they

* I hear now that they are Flies, and not really Mosquitos. But as Mosquitos are really Flies, and as these Flies bite severely, I shall continue to speak and to feel about them as if they really were.

went I followed, and in all these places were Mosquitos—as where were they not?—yet still I could never actually see one pursued and caught; but this was soon to be vouchsafed me. A tiny rill, which winds here amidst tiny hills, clothed with tiny birch trees and only at its mouth becomes stream-like, debouches, if so large a word may be used of it, into this part of the lake; and along its windings fringed on each side with masses of grey stone-like slag that have become moss-covered and even support stunted tree-bushes, I followed one of these Phalaropes, and in the little fairy pool, in which the expansion of its waters begins, I saw this bird excitedly pursuing and deftly catching these pests, and that at so close a distance that the glasses were not at all needed, though they greatly added to the vindictive pleasure of the sight. The avenger—alas! how imperfect a one—turned, zig-zagged, skurried, strained upwards, pressed, in a foot's length, to all points of the compass, and especially kept hugging every nook, angle, jetty, or little indentation of the shore, and almost at every little pretty, soft snap, might have said, like Cleopatra to her “betrayed” fishes, each representing an Antony—“Ah, ha, you're caught!” Then out of some similar configuration, swam the other riparian investigator—larger than the first, its partner evidently, which, if all tales be true, should make it the female—catching Mosquitos all as ardently. There was nothing but Mosquitos, and nothing more seemed wanted. The air was full of them, and never was hunt more successful. Never, too, surely, could a pair of little birds have been seen, prettier, at once, and occupied more meritoriously. The first perhaps, and the second just possibly, but surely not the two in conjunction.

(To be continued.)

A CATALOGUE OF THE LAND AND FRESHWATER
MOLLUSCA OF SUSSEX.

By E. W. SWANTON.

(Member of the Conchological Society; Curator of the Educational Museum,
Haslemere.)

(Continued from p. 268.)

(PLATE III.)

Helicella itala, Linné (= *H. ericetorum*, Müller).—Widely distributed, abundant on the Downs, absent from the Vectian sands. Subject to great variability in size and colouring. Mr. Jenner has taken shells 20 mm. in diam. at Eastbourne, and dwarfed specimens on the Downs near Lewes. The Rev. W. A. Shaw has found this species in a Holocene deposit at West Stoke.

Var. *hyalozonata*, Cockerell.—Near Beachy Head (A. G. Stubbs); Rottingdean (F. Burrows); Friston, near Eastbourne (C. H. Morris).

Var. *leucozona*, Moquin-Tandon.—Downs near Lewes (Jenner); Heyshott Down (E. W. S.).

Var. *alba*, Charpentier.—Lewes (T. S. Hillman); Kingston Hill (C. H. Morris); Downs at Lewes, Seaford, and about Beachy Head (Jenner).

Var. *bizonalis*, Moquin-Tandon.—Near Lewes and Seaford (J. H. A. Jenner).

Var. *coalita*.—Downs near Eastbourne (Rev. W. L. W. Eyre).

Var. *grisescens*, Colbeau (= *subpellucida*, Jenner).—Wilmington Hill (J. H. A. Jenner).

H. caperata, Montagu. (Plate III.)—Generally distributed. Borrer noted that it is very partial to clover fields, and is a favourite morsel with the Land-Rail. The Rev. W. A. Shaw has found it in a Holocene deposit at West Stoke. Large forms have been observed



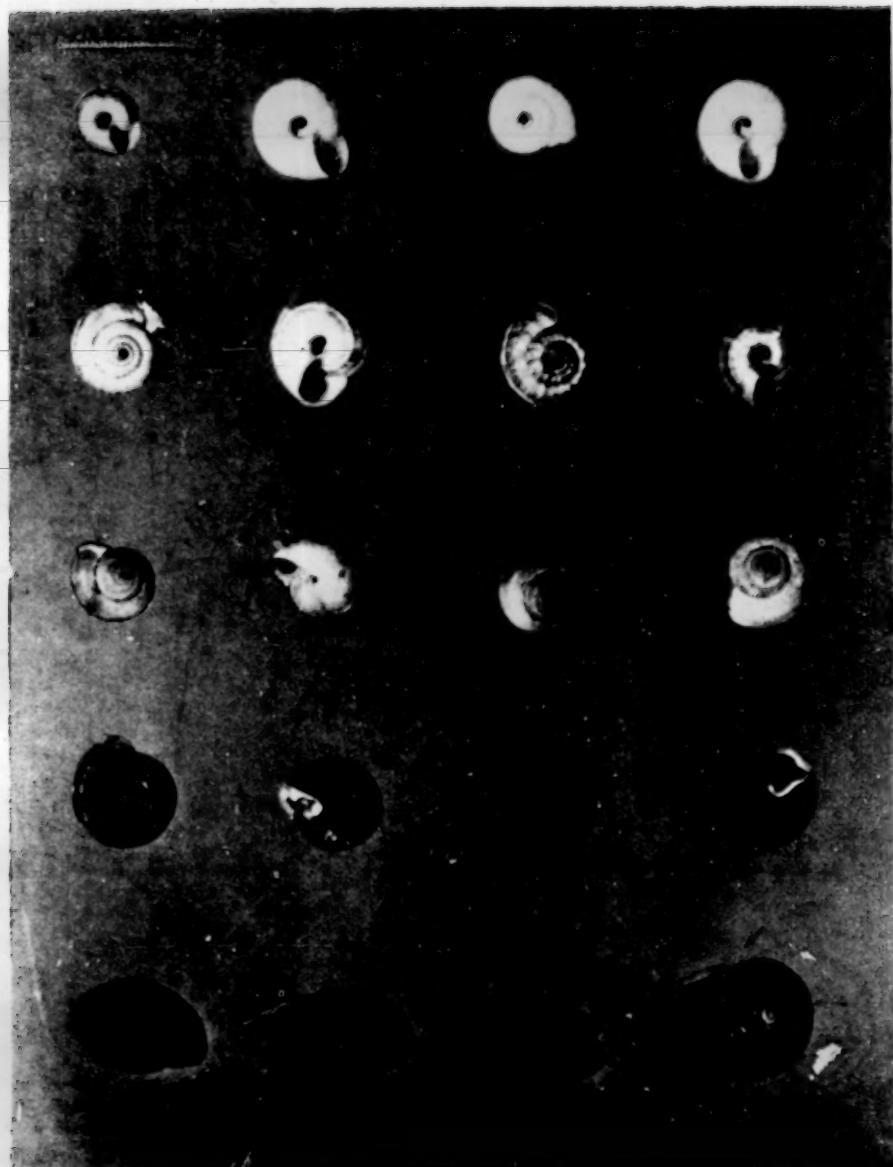


Photo W. H. Thornton.

SUSSEX MOLLUSCA.

HELICELLA CAPERATA, **H. HERIPENSIS**, **H. CARTUSIANA**, **HELICODONTA OBVOLUTA**, and **HELICIGONA LAPICIDA**. (See p. 319).

by Mr. Jenner on the Downs about Lewes, and by Mr. C. H. Morris at Cliff Hill, Ranscombe, and at Eastbourne.

Var. *ornata*, Picard.—The Rev. S. Spencer Pearce has suggested that the conspicuous dark band which characterizes this variety, causes it to be avoided by sheep. Lewes (T. S. Hillman); locally common on the Downs near Lewes (J. H. A. Jenner); Hastings, common (Hastings Philosophical Society); Heyshott Down (E. W. S.).

Var. *alba*, Picard.—Lewes (C. H. Morris); Ranscombe, near Lewes (J. H. A. Jenner); near Little Common, Bexhill (Rev. W. A. Shaw).

Var. *bizonalis*, Moquin-Tandon.—Near Lewes (J. H. A. Jenner).

Var. *fulva*, Moquin-Tandon.—Near Lewes (J. H. A. Jenner).

Var. *obliterata*, Picard.—“Victoria Drive,” near Eastbourne (A. G. Stubbs); Kingley Vale, near Chichester (Rev. W. A. Shaw).

Var. *gigaxii*, Charpentier (? *H. heripensis*, Mabille).—“Some shells from the Downs about Lewes are perhaps the var. *gigaxii*” (J. H. A. Jenner); occasionally in the Chichester district, where the “species generally has a tendency to this form” (W. Jeffery).

Var. *subscalaris*, Jeffreys.—Near Lewes (J. H. A. Jenner).

Monst. *sinistrorum*.—A full-grown specimen on the golf-links at Lewes (C. H. Morris).

H. heripensis, Mabille. (Plate III.)*—This species was first recorded as British by Mr. A. W. Stelfox in Proc. Malacological Society, March, 1912. It bears the same relation to *H. caperata* that *Vallonia excentrica* does to *V. pulchella*, the chief distinguishing feature being the wide, deep, and excentric umbilicus which exposes the coiling of the whorls. The Rev. C. E. Y.

* DESCRIPTION OF PLATE III.—Line 1: Three shells of *Helicella heripensis*, Mabille, var. *albicans*, Kendall, and one (the extreme left) of typical *Helicella caperata*, Montagu, to show the difference in the umbilicus. Line 2: Four shells of typical *Helicella heripensis*. Line 3: Four shells of *Helicella cartusiana*, Müller. Line 4: Four shells of *Helicodonta obvoluta*, Müller; the second on the left shows the white epiphragm which covers the mouth of the shell during hibernation. Bottom line: at the extreme left a typical shell of *Helicigona lapicida*, L.; adjacent is the var. *ecarinata* subvar. *subangulata*, Pascal; to the right are two scalarid shells, monst. *scalare* subvar. *subscalaris*, Grateloup. All natural size.

Kendall remarks (Journ. Conch., July, 1912) that variation in colour exists to a certain degree, but does not seem so great as in *H. caperata*, that it is strongly calcophilic, and also xerophilic, occurring always on dry pastures, and that it is probably not a "strong" species, as it seldom seems to be the dominant. Lewes, 1908 (Rev. C. E. Y. Kendall); Ovingdean, near Brighton, November, 1910, very fine specimens (Rev. C. E. Y. Kendall).

Var. *albicans*, Kendall.—Near Brighton (Rev. C. E. Y. Kendall).

H. barbara, Linné (= *Helix acuta*, Müller).—Recorded only from the neighbourhood of Eastbourne and Hastings. Mr. Jenner remarks that "this species is now lost to East Sussex, the ground where it occurred at Eastbourne having been built upon [near Mill Gap]. The form which occurred there was white, opaque, and very large, some specimens reaching 18 mm. in length. I have searched the coast of Sussex from Brighton to Rye, in every likely place, without finding another locality for this shell, and it seems most probable that this now extinct colony was introduced" ('Journal Conch.', vi., July, 1891). Mr. A. J. Alletsee has recorded its occurrence at Ore, Hastings.

H. cantiana, Montagu.—Generally distributed, excepting on the Vectian sands about Blackdown.

Var. *rubescens*, Moquin-Tandon.—Near Lewes (J. H. A. Jenner); Guestling (Hastings Phil. Soc.); Ore, Hastings (A. J. Alletsee).

Var. *albida*, Taylor.—Near Lewes (J. H. A. Jenner and C. H. Morris).

H. cartusiana, Müller. (Plate III.)—Captain Thomas Brown wrote (in 1844):—"This species inhabits the chalk districts of Sussex and Kent, among short grass, and is also common on the coast between Dover and Brighton." Mrs. Merrifield remarked in her 'List of the Land and Freshwater Shells of Brighton' (1864) that it is "particularly abundant on our chalk Downs near the sea." Mr. Jenner says "it occurs on the chalk, rather common, but very local" (as is indicated by the recorded stations for it); he has taken large forms 15 mm. in diam. in several spots near Lewes. Downs near Lewes in several places (J. H. A. Jenner); Malling Marsh, near Lewes (Ed. Collier, Journ. Conch. xiii. 285); Lewes, on stunted grass near Mount Caburn, and on Ranscombe Brow, very local (W. C. Unwin); near East Dean on

the Downs, Eastbourne (A. G. Stubbs); between Blatchington and Seaford (Eastbourne Nat. Hist. Soc.); Shoreham (W. Jeffery); Littlehampton (Gwyn Jeffreys).

Var. rufilabris, Jeffreys.—Lewes (T. S. Hillman and Gwyn Jeffreys); Littlehampton (Gwyn Jeffreys); Ranscombe (J. H. A. Jenner).

Var. lactescens, Picard (= *alba*, Jenner).—Lewes (J. H. Jenner and T. S. Hillman).

Hygromia fusca, Montagu.—A Lusitanian species of great rarity in Sussex. Mrs. Merrifield, in 'The Natural History of Brighton' (1860), remarks that it is "rare in this neighbourhood, found occasionally creeping among brambles"; Mr. W. C. Unwin found two specimens in Warrington Wood, Lewes (1852); and Mr. W. Jeffery has recorded it from Ratham, near Chichester (1882), see Journ. Conch. iv., 17. It is of interest to note that the Rev. W. A. Shaw has recorded it from Surrey, on the slopes of Hindhead, only a few miles from the Sussex border (1911).

H. granulata, Alder (= *sericea*, Jeffreys).—A rare species. It has been found by the Rev. W. A. Shaw in a Holocene deposit near West Stoke, Chichester; Mr. Jenner records it from Cowfold and Henfield, and Mr. Guermonprez from Bognor. "It is recorded as taken at Hastings in 'Diplock's Guide,' but has not been met with recently" (J. H. A. Jenner).

H. hispida, Linné (= *H. concinna*, Jeffreys).—Generally distributed.

Var. hispidosa, Mousson (= *H. hispida*, Jeffreys).—Widely distributed.

Var. depilata, Alder.—Lewes and Ashcombe, not common (W. C. Unwin); Up Park (F. Townsend, Haslemere Museum collection).

Var. albida, Jeffreys.—Pevensey (A. J. Alletsee); Hastings (Hastings Phil. Soc.); West Stoke (Rev. W. A. Shaw).

Var. subrufa, Moquin-Tandon.—Lewes (Jenner); Mount Caburn (Morris); near Hastings (Hastings Phil. Soc.); Heyshott Down (E. W. S.).

Var. nana, Jeffreys.—Heyshott Down (E. W. S.).

Var. conica, Jeffreys.—Hastings (Hastings Phil. Soc.); Brighton (specimens in Rufford collection, Hastings Museum).

H. rufescens, Pennant.—Generally distributed. The Rev.

W. A. Shaw has found it in a post-Pliocene deposit at Kingley Vale, West Stoke (1912).

Var. *albocincta*, Cockerell.—Amberley Castle (D. Taylor); Winchelsea (Rufford Collection, Hastings Museum).

Var. *rubens*, Moquin-Tandon.—Near Lewes (Jenner); Winchelsea (Rufford Collection).

Var. *alba*, Moquin-Tandon.—Lewes (C. H. Morris and W. C. Unwin); Winchelsea (Rufford Collection); Eastbourne (Hastings Phil. Soc.); Chanctonbury Ring (E. W. S.); Heyshott Down (E. W. S.); West Stoke, near Chichester (Rev. W. A. Shaw).

Acanthinula aculeata, Müller.—Widely distributed. Specimens in the Haslemere Museum were collected at Hastings by F. Townsend in 1850. There are numerous records from both divisions of the county.

Vallonia pulchella, Müller.—Probably generally distributed, but the numerous published records of its occurrence at Lewes, Hastings, and Eastbourne, and about Harting and Chichester, were made before the form with excentric umbilicus (*V. excentrica*, Sterki) was raised to specific rank.

V. costata, Müller.—According to Dr. Sterki the presence of very fine raised revolving lines on the nucleus of the one and a half embryonal whorls distinguishes this species from *V. pulchella*, in which the nucleus is smooth. East Hill, Hastings (A. J. Alletsee); Eastbourne and Lewes (Jenner); Steynings (Rev. C. E. Y. Kendall); Chanctonbury Ring and Heyshott Down (E. W. S.); West Stoke, near Chichester (Rev. W. A. Shaw), about Ifield and Rusper (E. W. S.).

V. excentrica, Sterki.—Formerly confused with *V. pulchella*, from which it differs in the markedly excentric and less open umbilicus, and the more impressed sutures of the inner whorls. Near Kingley Vale, Chichester (Rev. W. A. Shaw); Verdley, near Midhurst (E. W. S.).

Helicodonta obvoluta, Müller. (Plate III.)—This species, being of exceptional interest, the records of its distribution in Sussex require consideration in detail. It is of Lusitanian origin. Its range in Britain at the present time is the South Downs over a tract in Sussex and Hants about thirty-five miles in length, and about six miles in breadth. It is not dispersed entirely over that area, but occurs in isolated colonies; in some spots only dead

shells are found, *e. g.* the Rev. W. A. Shaw found it in a post-Pliocene deposit at Kingley Vale, near Chichester, an indication that it is a waning species, which is supported by the occurrence of dead shells only in parts of Surrey and Kent. It is always associated with beech trees, ascending the trunks in spring upon emergence from hibernation and spending the summer on the branches. To secure living specimens it is necessary to visit the trees at the time of the spring ascent or the autumn descent, for amongst the moss and leaves at the base only dead smooth shells are met with; living specimens of all ages show the epidermis clothed with hairs.

Some years ago, upon pointing out the shell to an old gamekeeper at Ditcham, he remarked that he knew it well, and that once when digging out rabbits in the wood in winter he came across some of the shells "stuck together in a lump as big as my fist," an observation tending to show that these molluscs assemble for hibernation in the manner often adopted by *Helix aspersa*. I gave him my address, and promised to send him half-a-crown upon receiving a similar "lump," but the reward has not been claimed. As in *H. pomatia* the mouth of the shell is closed by a thick, white, chalky epiphragm during the period of hibernation. Weaver alludes, in 'The History of Harting' (1877) to the first British record of it (in 1830) by Dr. James Lindsay in Ditcham Wood on the Hants border, and adds: "We have since found it in another locality near Up Park, where, within the last dozen years or so, they were so plentiful that we have collected as many as thirty or forty specimens in less than three hours on several separate occasions."

Mr. Clement Reid exhibited specimens before the Linnean Society on December 18th, 1890, and showed by aid of a specially prepared map its present very local distribution in England. He informs me that it is quite common where it occurs, and is associated with *Clausilia rolphii*, and with plants belonging to ancient woods. It does not occur in the eastern division of Sussex. The following are the recorded stations in the western part of the county. "Specimens evidently only recently dead, amongst moss at the roots of trees on a bank at Duncton" (T. Godlee, J. C., 1895); dead shells only at Woodend "at the base of the Downs" (W. Jeffery); Winden Wood, near Arundel

(Clement Reid) ; all along the hillside from Buriton (Hants) to the dell, Treyford, where it is common, in beech woods chiefly, and specially near water (J. Gordon) ; Singleton and Graffham (W. Jeffery and many others) ; Bignor Hill ; Glatting Hangar ; Farm Wood, Sutton, Barlavington Hangar, and Woolavington Hangar (Clement Reid) ; Hangar above Heyshott Farm (E.W. S.) ; William Wood, Up Park (Rev. W. A. Shaw).

Helicigona laticida, Linné.—Widely distributed, particularly abundant in beech woods.

Var. *ecarinata*, A. Schmidt. (Plate III.)

The subvar. *subangulata*, Pascal, has been taken at Lavant by the Rev. W. A. Shaw.

Var. *albina*, Menke.—Light greenish white specimens at Lavant, May, 1904 (Rev. W. A. Shaw).

Monst. *scalare*, Charpentier. (Plate III.)

The subvar. *subscalaris*, Grateloup, has been taken at Lavant by the Rev. W. A. Shaw.

H. arbustorum, Linné.—Widely distributed, but absent from the Vectian sands about Blackdown. Mr. P. J. Johnson has found it in a Pleistocene deposit on the foreshore at West Wittering.

Var. *picea*, Rossmässler.

Subvar. *fusca*.—Ecclesbourne Glen, Hastings (G. H. Rowe).

Var. *flavescens*, Moquin-Tandon.—Lewes (J. H. A. Jenner and others) ; Boopée, Hastings (Hastings Phil. Soc.).

Var. *fuscescens*, Duchaissing (= *marmorata*, Taylor).—Lewes, Pells, and Landport (Jenner) ; between Robertsbridge and Hurst-green (T. D. A. Cockerell).

Var. *cincta*, Taylor (= *pallida*, Taylor).—Pells, Lewes (T. S. Hillman).

Var. *conoidea*, Westerlund.—Pells, Lewes (J. H. A. Jenner).

(To be continued.)

NOTES AND QUERIES.

MAMMALIA.

Natterer's Bat in Staffordshire.—The first authenticated occurrence of this Bat in Staffordshire, of which I have knowledge, has recently been recorded by Mr. B. Bryan, of Longton, Staffordshire. For many years he and I have been working out the Bats of our county, and on the evening of May 6th last, about a mile from Longton, one of the towns now constituting the Borough of Stoke-on-Trent, he observed, about 7.30 p.m., in broad daylight, a Bat flying leisurely, and with an undulating flight, apparently hawking flies just over the grass by the side of the road. He managed to catch the little animal, and at once saw it was a Reddish-grey or Natterer's Bat (*Myotis nattereri*, Kuhl.). The identity of the species has since been confirmed by several leading authorities on the subject. Although quite uninjured, the Bat refused to feed in captivity, an unusual thing with most British Bats, and died. This makes the eighth species on our Staffordshire list (see my paper on "Staffordshire Bats" in the 'Transactions of the North Staffordshire Field Club,' vol. xlvi. 1908, p. 12). Natterer's Bat appears to have been recorded only once for the counties of Salop, Derbyshire, and South Lancashire (see Coward & Oldham's 'Fauna of Cheshire,' p. 12), and the distribution and range of our British Bats still wants working out. I shall be glad to receive specimens for identification from any part of England.—JOHN R. B. MASEFIELD (Rosehill, Cheadle, Staffordshire).

Albinism in the Serotine Bat.—A Serotine Bat (*Vesperugo serotinus*, Blas.) sent to me by Mr. F. E. Blagg, from Hampshire, in the flesh, on July 5th last, has a band of white fur extending across the breast of the animal. This gives the Bat a most striking appearance, and is, as far as I am aware, the first instance of any trace of albinism or other colouration variation in this species. Mr. A. Whitaker, of Barnsley, informs me that albinos have been recorded in the Barbastelle, Long-eared, Daubenton's, Whiskered, Lesser Horseshoe, and Pipistrelle Bats. Also cream and buff varieties of the

Long-eared Bat, and melanic and other varieties of the Pipistrelle.—
JOHN R. B. MASEFIELD (Rosehill, Cheadle, Staffordshire).

Colour Discrimination in Dog; Dog separating Combatants.—A Russian Sable Pomeranian will not go near anything red, and has a decided preference for pale blue. Repeatedly rags of each colour have been given him to play with, and he has never been known to touch a red one, while the blue or green have been ripped to pieces in a very short space of time. A Retriever was nicknamed the "Policeman" because he would always separate two other Dogs who were fighting, or those which looked as if they might. He would always tackle the aggressor, and not leave him until the dog attacked was safely away.—(Miss) R. HOLLOWAY.

Vegetarian Appetite in Cat.—It was never safe to leave a Persian cat near cucumbers. He has often eaten one in the night. Besides this, he has a distinct love for peas, beans, grapes, figs, dates, and potato-parings.—(Miss) R. HOLLOWAY.

A V E S.

Singular Nest of Willow-Wren.—This morning, August 4th, 1915, I noticed a small bird fly into a Crimson Rambler rose on the old wall which divides my garden from a neighbour's. I sent my gardener for a ladder, and found, at a height of about eight feet from the ground, the nest of a Willow-Wren, with young birds just ready to fly. Two or three of them, which we disturbed, are now about the lawn, giving their parents much anxiety; the rest are still being fed in the nest, which is so overweighted as to look almost like a Sparrow's nest with poultry feathers hanging out. No doubt there are records of this species breeding late, and placing the nest high above the ground; but the combination, I imagine, must be unique.—W. WARDE FOWLER (Kingham, Chipping Norton).

Notes on the Laying of the Cuckoo and the Removal of Eggs of Foster-Parent.—Although so much has been written of the life-history of the Cuckoo, there still appear to be many queries that require additional observations recording, and it would be of interest if those who have information at first-hand would give their personal experiences. The Cuckoo evidently does not wait until a full clutch is laid by the foster-parent, but places its egg in the nest when one or more eggs have been laid. I have never known an instance, however, of its eggs being placed in the nest before an egg had been

deposited therein by the foster-parents. Occasionally the egg of the Cuckoo is the only egg found within the nest, but the probability is that the first egg of the foster-parent had already been removed. Again, I know the Cuckoo will deposit its egg several days after the foster-parents have started incubation, but what is known of the longest time allowed to elapse before so doing? Personally I believe this time is limited; if so, we must credit the Cuckoo with an instinct of knowing to what extent incubation has already taken place. The incubation of the egg of the Cuckoo is evidently more rapid than the eggs of the usual foster-parents, giving the dual advantage to the young Cuckoo of being hatched first, or, if the eggs had been deposited after the foster-parent had commenced to sit, then of being hatched at least about the same time. The same species of foster-parents are not invariably chosen by each individual Cuckoo, but, on the other hand, I believe the Cuckoo does frequently restrict itself to one kind of foster-parent as far as possible, so much so, as to considerably retard the time of its laying, as, for instance, when using the nest of the Reed-Warbler, which would be weeks after eggs of other Cuckoos had been deposited in such nests as the Pied Wagtail, Hedge-Sparrow, Robin, or Meadow-Pipit. And further, the Cuckoos that utilize the former nests are necessarily delayed in their return migration. I have recorded an instance ('Zoologist,' July, 1915, p. 270) of the Cuckoo laying four eggs all in the nests of Reed-Warbler, and I have known several instances where the same bird has laid at least several eggs in the nests of the same species of foster-parents; and, again, where one Cuckoo had selected nests of various kinds of foster-parents—in one instance a Greenfinch, Brown Linnet, and Chaffinch being chosen. How many eggs of the foster-parent are usually removed by the Cuckoo, and what actually becomes of them? In my experience I have only known two nests, those of a Sedge-Warbler and a Hedge-Sparrow, where I knew the complete clutch of the foster-parent was left intact, and such exceptions may prove nothing more than that the Cuckoo had been disturbed before it had time to carry out its full intentions. As a rule I believe at least one and often two eggs are removed and possibly three, but I have no actual proofs to support the latter statement. That the Cuckoo can lay a type of egg to assimilate to those of the foster-parents has often been asserted, but all my personal experience has been that the one female shows a remarkable similarity in each of her eggs, irrespective of the foster-parents, and, moreover, this similarity is continued year by year. And, further, the young of the Cuckoo inherits to a

great extent the type of egg laid by the parent bird.—J. STEELE ELLIOTT.

Calling of the Cuckoo in July.—The late Mr. Howard Saunders in his 'Manual of British Birds' states that the Cuckoo calls up to June 20th. To fix such a precise date is rather an emphatic statement for such an authority to make, and certainly one that is in error. That the continuous calling ceases about that date would have been more correct, but I have many notes from Bedfordshire of their calling even in July. My friend the late Mr. J. King heard the Cuckoo at Biggleswade as late as July 8th in 1897, and until July 17th in 1899, a female on July 6th and a male on July 9th in 1900, July 4th in 1901, and July 15th in 1902. Personally I heard them frequently in various localities up to July 7th in 1907, and in the present year at Turvey on July 4th, when at 6 a.m. I heard a female call once and a male call loudly and frequently for some ten minutes or more. That in some localities the calling ceases at a much earlier date than in others I am fully aware, and at my home in Shropshire, where I have kept close observation the present year, I have not heard or seen an adult since June 16th. The return migration of the adult Cuckoo is given as in July and August, but I think it practically takes place as soon as their calling ceases and the majority of our birds have taken their departure even before the end of June. It is unfortunate that the Reports of Migration printed in the 'Bulletin' of the British Ornithologists' Club throw very little light on the return movements of the adult Cuckoo, as in the few records given so very few state whether such refer to the old or young birds.—J. STEELE ELLIOTT.

Buff-backed Heron in Somerset.—A specimen of the Buff-backed Heron was shot at Martock, Somerset, on January 28th, 1909, and preserved as a skin by a Mr. Sherring. I received the specimen from a friend of Mr. Sherring, and sent it to Mr. Ogilvie-Grant, who verified my suspicions as to the species. The data are preserved, pinned around the neck of the bird, which unfortunately has a rather neglected appearance. This is, I think, the only occurrence in Somerset, and a rarity for any part of England.—STANLEY LEWIS (Wells, Somerset).

Notes on Nest-boxes.—Our nest-boxes this season have contained nothing new or of special interest, except the brood of Tawny Owls already recorded on p. 232. Three boxes have been occupied by Stock-Doves, but they have not been very successful, as I believe only one brood got away. In one case both eggs had been taken out

of the box and lay on the ground under the tree, one broken and the other intact. What marauder had done this is a puzzle. In other boxes we have had Great Tit, Blue Tit, Coal Tit (one), Nuthatch (one), Tree-Sparrow (many), House-Sparrow, and Starling. The box used by the Nuthatch had been in the same place for quite twenty years, and fell down when there were two or three eggs in it, but though it was mended up and replaced, the bird did not return, nor did she use another box. Tree-Sparrows have taken more boxes than was desirable, and have greatly increased in numbers during the last few years. The nest can be easily distinguished from that of the House-Sparrow, as it usually contains moss and fresh green leaves, and is much more tidily put together.—JULIAN G. TUCK (Tostock Rectory, Bury St. Edmunds, Suffolk).

Migration of Swifts.—By far the largest concourse of Swifts (*Cypselus apus*) I have ever witnessed in the Midlands was over the Dowles Valley, near my home, at 6 p.m., on August 9th. My son and I each estimated their numbers at upwards of five hundred birds, and they covered an area in the sky of perhaps half a mile across, and were at an altitude of about 1000 ft. Although the air was charged with insect life, at least at a lower altitude, they did not appear to be feeding, but gathering together for a migratory movement. Numbers of them circled out at times to various points of the compass, but they all eventually, but very slowly, passed away southwards, since when I have not observed any Swifts remaining in this locality.—J. STEELE ELLIOTT.

PISCES.

Four-bearded Rockling in the Colne.—Yesterday, July 22nd, 1915, in dredging for Oysters in the River Colne, near Brightlingsea, Essex, a specimen of this fish (*Motella cimbria*) was caught in one of the dredges. Its rarity excited attention from the dredger men, and the manager of the fishery, Mr. Trussell, found there were only four, as he termed them, worm-like appendages to its mouth. When I showed him Day's 'Fishes,' he at once recognized the fish. Unfortunately the fish was not preserved, but was thrown overboard again with other rubbish from the dredge.—HENRY LAVER (Colchester).

Behaviour of a Captive Rockling.—The Five-bearded Rockling whose behaviour was described by me in a paper in the May issue of 'The Zoologist' (pp. 190–193) died on June 10th. I should like to point out that there were no alterations in its behaviour beyond those which were described.—H. N. MILLIGAN.

CRUSTACEA.

The Resting-place of a Velvet Crab.—On the morning of February 9th a large male Velvet Crab (*Portunus puber*) was placed in an aquarium. It at once began to explore the tank, and to climb amongst the rocks. Some time before the next morning it had selected a cavity in the base of the rock-work at the back of the aquarium, and henceforth this cavity became its resting-place. The cavity was sufficiently deep to allow the Crab to sit inside, with only the front portion of its body and the great claws projecting. The Crab died on July 3rd. During the whole of the twenty and a half weeks it had lived in the tank it had never voluntarily moved more than four or five inches away from the entrance to the resting-place, and even these short excursions were always on the floor, never on the rocks, and were undertaken only under the stress of hunger. If the Crab was annoyed with the end of a rod, it would strike vigorously with its claws. Even if driven out of its hole it would move only a few inches away and then sit waiting for an opportunity to slip back again. I have several times gone to its tank after nightfall and suddenly turned on the electric light, but I never found it wandering about the aquarium. It would sometimes seize passing Prawns with a very quick and sudden inward movement of its two claws, and eat them whilst sitting at the mouth of its hole.—H. N. MILLIGAN.

INSECTA.

Hornets' Nest in the Ground.—Some of the lads in our village school reported the finding of a Hornets' nest in a furze-bush, and, being rather doubtful, I went to look at it. A boy who acted as my guide assured me, "If you poke them up they'll come out." His remark was quite accurate; I did poke them up, and they did come out. To destroy the nest I had to find the entrance-hole, which was in the ground under the bush, and one of the Hornets stung me on the right cheek. The effect of the sting was not nearly so severe as I expected. I got home as soon as I could and applied my usual remedy of whisky well rubbed in, with the result that the swelling was very slight, and the pain no more than that of a Wasp-sting, while the after-effect was practically *nil*. Last year (*vide 'Zoologist,'* 1914, p. 277) a Hornet's nest was begun in one of our bird-boxes, but this was the only nest I have ever seen in the ground. One dose of cyanide fluid made an end of it, and the boys dug out the comb, the queen being produced for my inspection.—JULIAN G. TUCK (Tostock Rectory, Bury St. Edmunds, Suffolk).

